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Quantitative Augmentation via Neuro-evolutionary Technologies toward Ubiquitous Modeling (QuANTUM)

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<http://hdl.handle.net/10945/58696>

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Quantitative Augmentation via Neuro-evolutionary Technologies toward Ubiquitous Modeling (QuANTUM)



Major D. M. Smalenberger, Ph.D.
Quantitative Augmentation

AF/A9

14 May 2018

Variation 4

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Classification: Unclassified



The Air Force, and many organizations, faced severe challenges:

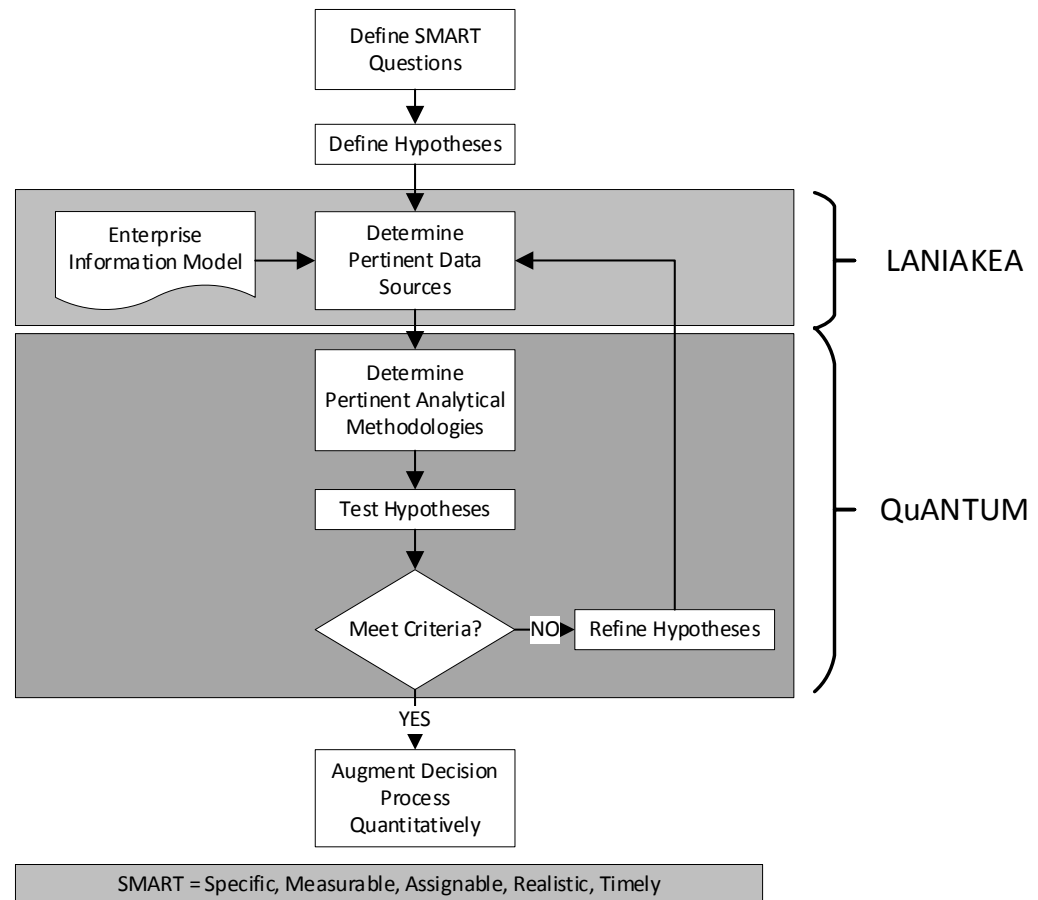
- **Limited exposure to hypothesis testing**
- **Insufficient substantiation due to “data anemia”**
- **Insufficient analytical rigor to justify position**
- **Lack of analytical knowledge available**
 - **Scientific analysts are in high demand and low supply**
 - **Assumptions to use a methodology are often overlooked**
- **Lack of toolsets to carry out necessary analytics**
 - **Network policies guard security but limit analytical capability**
 - **Tools are expensive and not purchased for the enterprise as a whole**
- **Lack of common language to communicate position DoD-wide**
 - **Based on English and not on math (e.g. Fully-Burdened Cost)**
 - **Undefined, Ambiguous, or inconsistent definitions**



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Quantitative Augmentation as the Foundation for Decision Support

- Quantitative Augmentation (QA) injects the scientific process into the decision process
- QA couples the four tenants of scientific experimentation:
 - Hypothesis
 - Data (Observations)
 - Methodology
 - Test
- Ensure that hypotheses can be substantiated or repudiated
- Results can be replicated

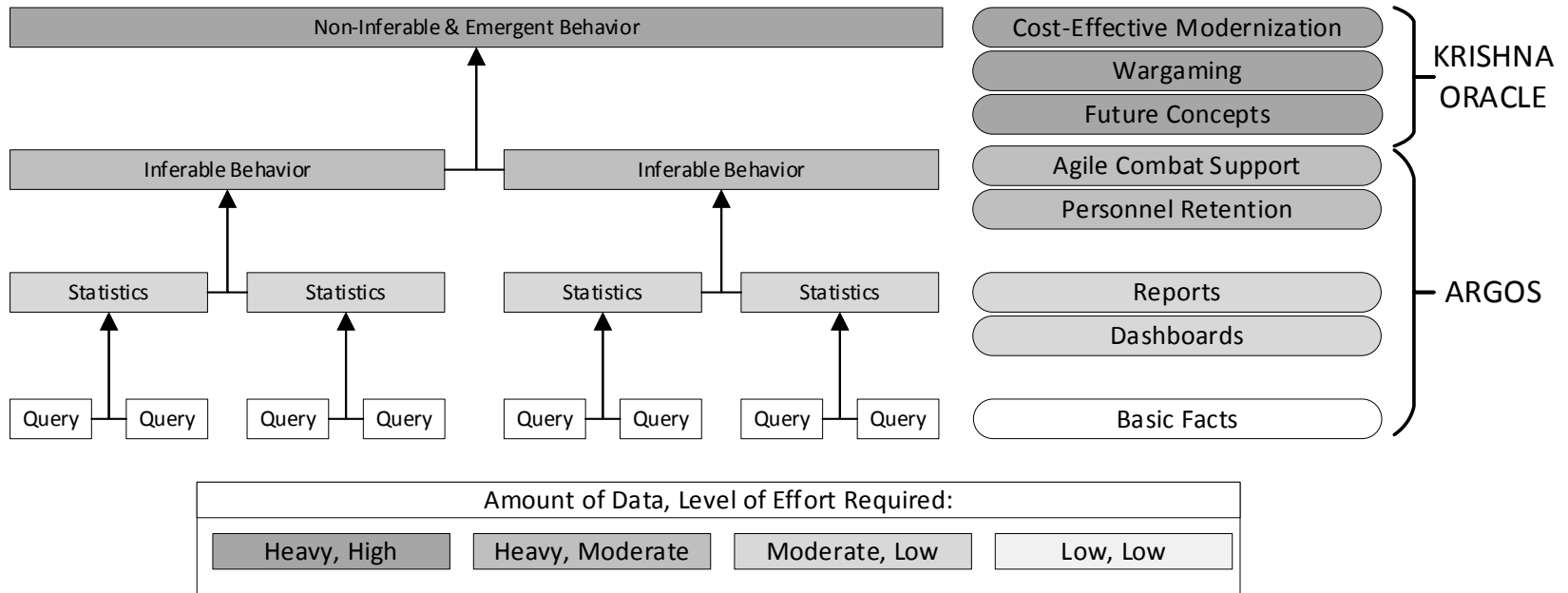




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Question Hierarchy

- There are different categories of S.M.A.R.T. Questions
- Each requires a modified or different methodology or methodologies to address
- Understanding the type of question is the first step to answering it





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M³ Paradigm

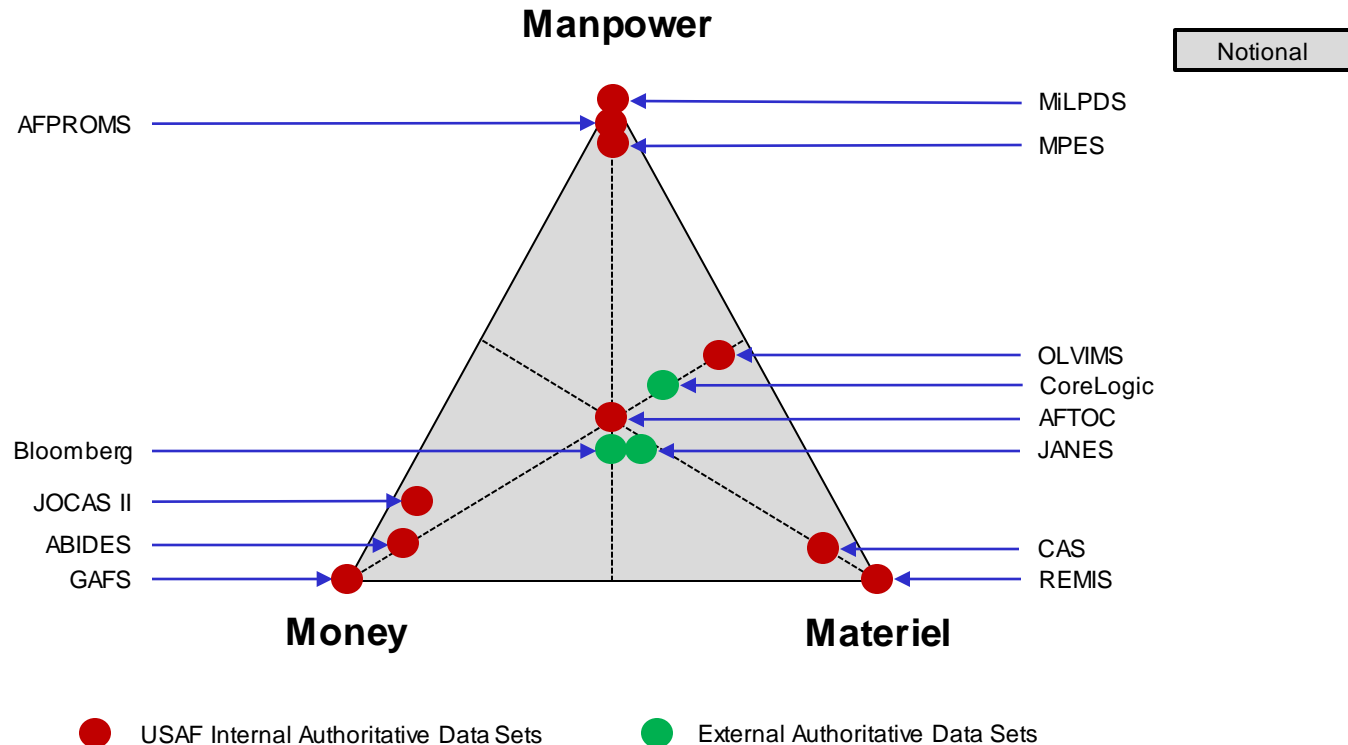
We may dissect most senior-level enterprise-wide questions into three core tenants:

Manpower

Money

Materiel

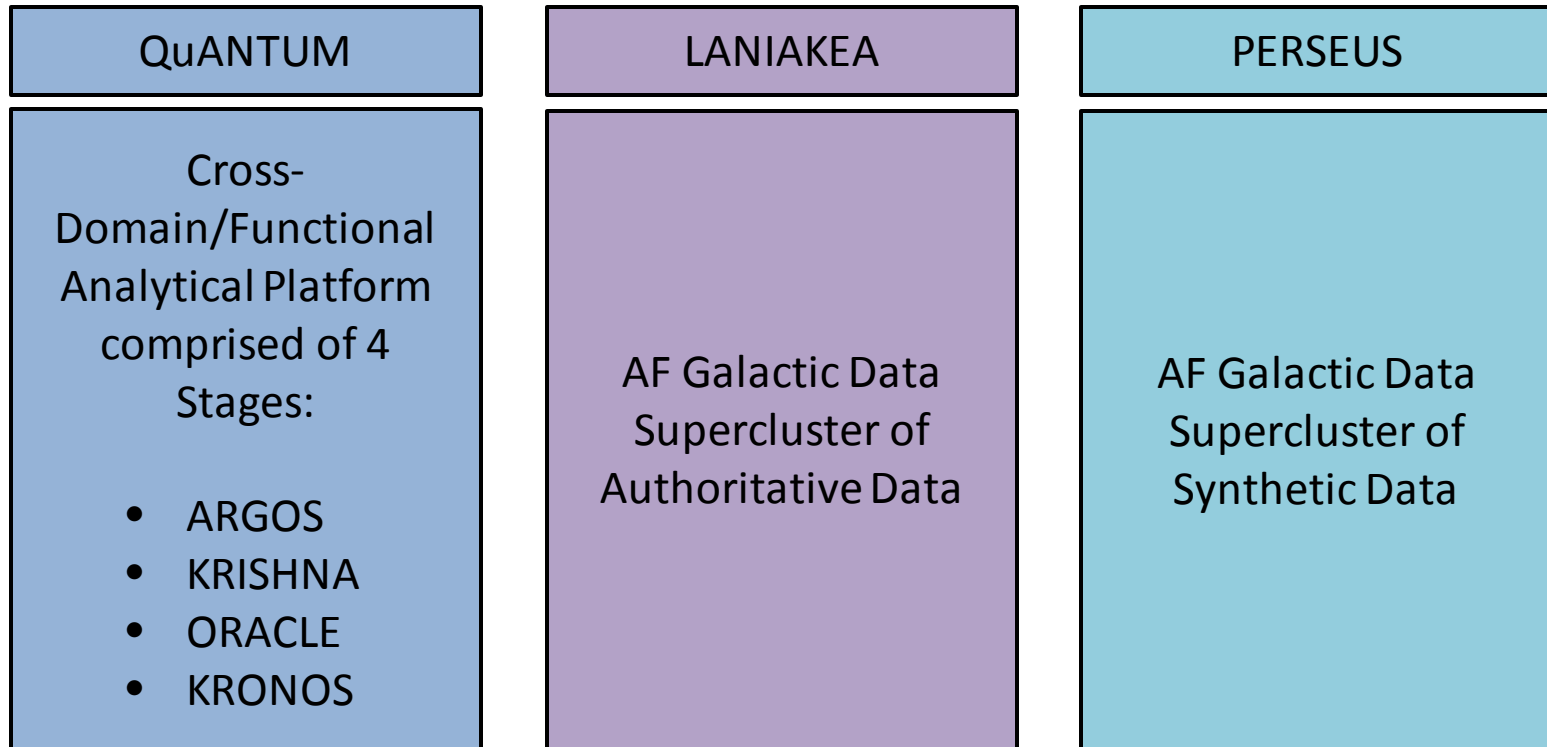
...and map authoritative data sets to those...





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Strategic Overview





QuANTUM Breakdown (con't)

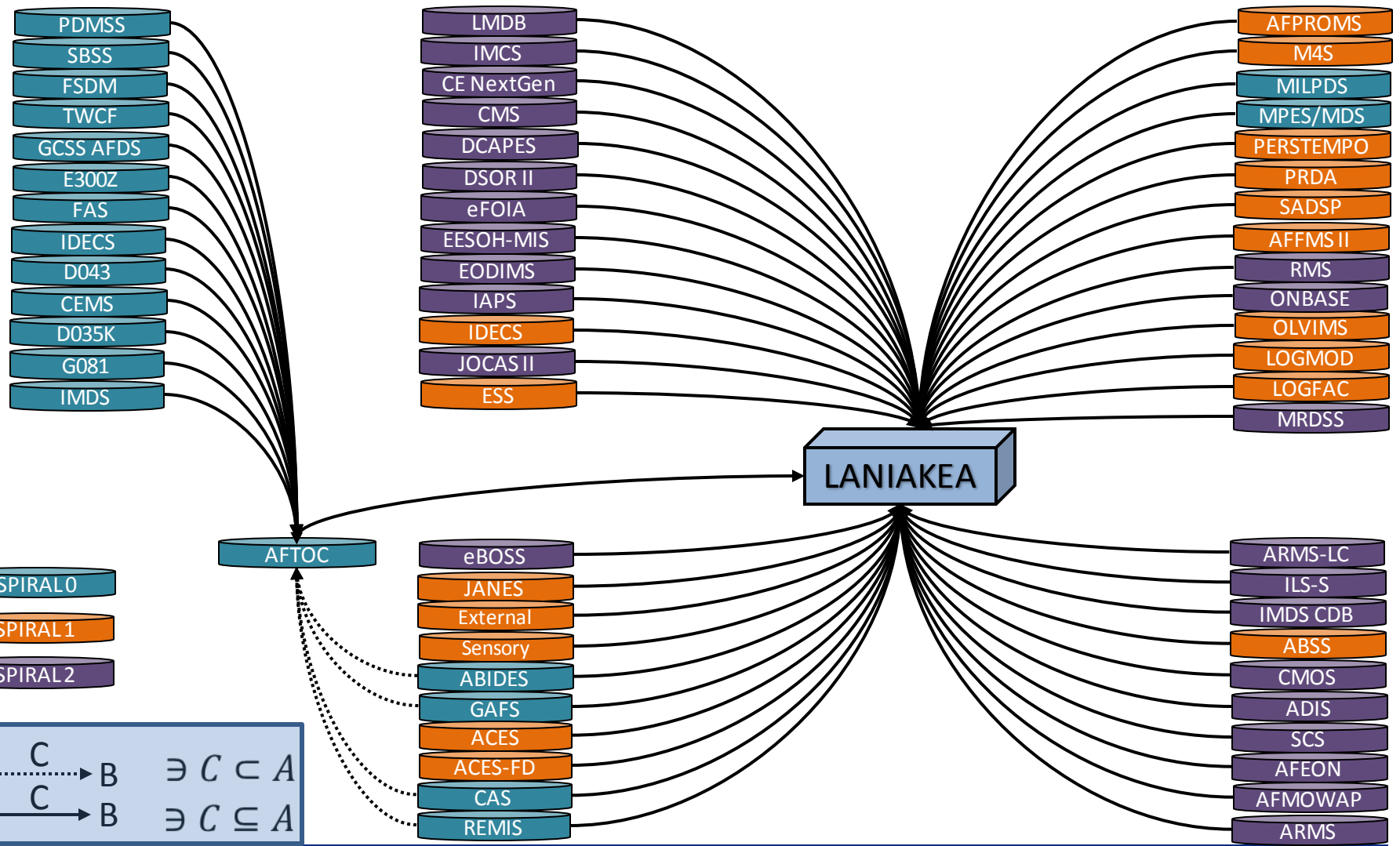
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- **ARGOS**
 - Provides insights into potential historical relationships
 - Requires historical, authoritative data (via LANIAKEA)
- **KRISHNA**
 - Provides prescriptive solutions to AF portfolio configuration
 - Evaluates aggregated and emergent-types of effects (e.g. effectiveness, lethality, agility, etc.) stochastically via massively distributed, parallel, physics-based, imperfect information, multi-AI-driven simulations at the campaign/multi-campaign level.
- **ORACLE**
 - Provides postulation of new weapon system platforms
 - Solution requires traversing multi-variate capability-to-cost curve
 - Requires Specifications-to-Cost hypersurface via QuANTUM-ARGOS
- **KRONOS**
 - Provides multiple improved portfolio scheduling trajectories to move from a current portfolio to an improved solution given a constraint set
 - Technical Term: Resource-Constrained Weighted Scheduling Optimization Problem (RCWSOP)



LANIAKEA Breakdown

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Future Deliverables Synopsis

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- **Active Cloud instance (LANIAKEA) that QuANTUM can access**
 - **Cloud storage**
 - **Cloud computing**
 - **Redundant backups**
 - **Tailored cost based on use**
- **Virtual and analytical platform for development and access to LANIAKEA: ARGOS**
- **Data Portfolio-as-a-Service (DPaaS)**
- **Algorithmic Portfolio-as-a-Service (APaaS)**
- **Validate platform's utility based on complex AF issues:**
 - **Agile Combat Support (support tail of the AF, ~40% TOA)**
 - **Personnel Recruitment & Retention (PR&R)**
- **Data Reports**
- **Lessons Learned**



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Questions?



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